State of New Mexico
LEGISLATIVE EDUCATION STUDY COMMITTEE

State Capitol North, 325 Don Gaspar, Suite 200
Santa Fe, New Mexico 87501
PH: (505) 986-4591 FAX: (505) 986-4338
http://legis.state.nm.us/lcs/lesc/lescdefault.asp

June 7, 2006

MEMORANDUM

TO: Legislative Education Study Committee

FR: Kathleen Forrer

RE: **STAFF BRIEF: MATH AND SCIENCE EDUCATION INITIATIVE: FEDERAL MATH AND SCIENCE LEGISLATION**

The 2006 Interim Workplan of the Legislative Education Study Committee (LESC) includes a report on federal mathematics and science legislation currently under consideration by the US Congress. At present, there are at least six bills in the US House of Representatives and four bills in the US Senate that could affect K-12 and/or higher education. In addition, the White House announced its own initiative in January 2006.

Impetus for Legislation

There are two reports upon which most of the bills introduced to date have been based: *Innovate America: Thriving in a World of Challenge and Change* (see Attachment 1 for the executive summary) and *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (see Attachment 2 for the executive summary).

Innovate America

The Council on Competitiveness established the National Innovation Initiative in 2003 to:

- bring together America's top minds on innovation and create consensus and a structure for action;
- sharpen understanding of changes in the innovation process and how they can be harnessed for economic growth; and
- advocate an agenda to make the United States the most fertile and attractive environment for innovation.

Led by leaders from business, academia, labor, and both state and federal government, the National Innovation Initiative has produced the report, *Innovate America: Thriving in a World of Challenge and Change*, which includes recommendations organized into three broad categories: Talent, Investment, and Infrastructure. Under Talent, the report makes the following recommendations regarding K-12 and higher education:

- Build a National Innovation Education Strategy for a diverse, innovative and technically trained workforce [to:]

  - establish tax-deductible private-sector "Invest in the Future" scholarships for American S&E [science and engineering] undergraduates;
  - empower young American innovators by creating 5,000 new portable graduate fellowships funded by federal R&D [research and development] agencies;
  - expand university-based Professional Science Masters and traineeships to all state university systems; and
  - reform immigration to attract the best and brightest S&E students from around the world and provide work permits to foreign S&E graduates of US institutions.

- Catalyze the Next Generation of American Innovators [to:]

  - stimulate creative thinking and innovation skills through problem-based learning in K-12, community colleges and universities;
  - create innovation learning opportunities for students to bridge the gap between research and application; and
  - establish innovation curricula for entrepreneurs and small business managers.

Rising Above the Gathering Storm

On May 27, 2005, Senators Jeff Bingaman and Lamar Alexander sent a letter to the president of the National Academy of Sciences (NAS) notifying the NAS that the Energy Subcommittee of the Senate Energy and Natural Resources Committee would be a holding series of hearings "to identify specific steps our government should take to ensure the preeminence of America's scientific and technological enterprise." The senators requested the NAS to develop a report that would identify the "most urgent" challenges being faced by the United States in maintaining leadership internationally in science and technology and make appropriate recommendations for addressing those challenges. The result, in fall 2005, was *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, which makes recommendations in four areas: K-12 education, basic research, higher education, and incentives for innovation.

With regard to K-12 education, the report recommends increasing "America's talent pool by vastly improving K-12 science and mathematics education." To accomplish this objective, the report includes the following suggested actions:

- annually recruit 10,000 science and mathematics teachers by awarding four-year scholarships;
- strengthen the skills of 250,000 teachers through training and education programs;
- enlarge the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, or mathematics; and

- expand two existing approaches to improving K-12 science and mathematics education: statewide high schools that specialize in science, technology, and mathematics; and summer internships and research opportunities for both middle school and high school students.

With regard to higher education, the report recommends making "the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world." To accomplish this objective, the report includes the following suggested actions:

- increase the number and proportion of US citizens who earn bachelor's degrees in the physical sciences, the life sciences, engineering, and mathematics by providing 25,000 new four-year competitive undergraduate scholarships each year;
- increase the number of US citizens pursuing graduate study in "areas of national need" by funding 5,000 new graduate fellowships each year;
- provide a federal tax credit to encourage employers to make continuing education available to practicing scientists and engineers;
- continue to improve visa processing for international students and scholars;
- provide a one-year automatic visa extension to international students who receive doctorates or the equivalent in fields of national need to allow them to remain in the United States to seek employment;
- institute a new skills-based, preferential immigration option; and
- provide international students and researchers engaged in fundamental research with the same access to information and research equipment as is afforded US citizens and permanent residents.

White House Initiative

In his 2006 State of the Union Address, President Bush announced a proposal to "keep America competitive" by increasing financial support for basic research and improving mathematics and science education. The details of that proposal were released in February 2006 in a report entitled *American Competitiveness Initiative: Leading the World in Innovation*.

The American Competitiveness Initiative (ACI) commits $5.9 billion in the fiscal 2007 budget, and more than $136.0 billion over the next 10 years. As stated in the report, the ACI:

- doubles, over 10 years, funding for innovation-enabling research at key Federal agencies that support high-leverage fields of physical science and engineering: the National Science Foundation, the Department of Energy's Office of Science, and the National Institute for Standards and Technology within the Department of Commerce;
- modernizes the Research and Experimentation tax credit by making it permanent and working with Congress to update its provisions to encourage additional private sector investment in innovation;
- strengthens K-12 math and science education by enhancing our understanding of how students learn and applying that knowledge to train highly qualified teachers, develop effective curricular materials, and improve student learning;

- reforms the workforce training system to offer training opportunities to some 800,000 workers annually, more than tripling the number trained under the current system; and
- increases our ability to compete for and retain the best and brightest high-skilled workers from around the world by supporting comprehensive immigration reform that meets the needs of a growing economy, allows honest workers to provide for their families while respecting the law, and enhances homeland security by relieving pressure on the borders.

On April 18, 2006, President Bush issued an executive order creating the National Mathematics Advisory Panel to provide advice on the best use of scientifically based research on the teaching and learning of mathematics. The group is required to provide an interim report on its findings no later than January 31, 2007, and a final report no later than February 28, 2008. On May 15, 2006, the members of the panel were announced (see Attachment 3). Soon thereafter, on May 24, *Education Week* reported that some observers have noted that only one of the panel's members is currently teaching in a K-12 school, while others worry that the panelists' backgrounds will lead them to favor drill and practice at early grade levels "at the expense of problem solving."

Selected Federal Legislation

In both the US House of Representatives and the US Senate, a number of bills have been introduced that, among other provisions, seek to strengthen and improve mathematics and science education at the K-12 and postsecondary levels throughout the nation. The most recent of these bills discussed in this brief—H.R.5356, H.R.5357, and H.R.5358—were introduced on May 11, 2006. Nevertheless, it is the three *PACE Acts* that, as noted in *Innovation: America's Journal of Technology Commercialization*, appear to be "on the fast track."

US House of Representatives

H.R.4434 Based on the recommendations in *Rising Above the Gathering Storm*, H.R.4434 establishes a scholarship program at the National Science Foundation (NSF) for undergraduate students who commit to become science or math teachers at elementary and secondary schools; authorizes NSF to provide grants to institutions of higher education to establish master's degree programs for in-service science and mathematics teachers; expands the number of participants and lengthens the duration of the NSF summer teacher training institutes; appropriates funds to the Department of Energy (DOE) for the Laboratory Science Teacher Professional Development Program; and establishes training programs at NSF for preparing science and math teachers to teach Advanced Placement and International Baccalaureate courses in science and math. Introduced on December 6, 2005, H.R.4434 has been referred to the Subcommittee on Energy and to the Subcommittee on Research of the House Committee on Science. (Sponsor: Representative Bart Gordon/Cosponsors: 44)

H.R.4596 Also based on the recommendations in *Rising Above the Gathering Storm*, H.R.4596, the *Sowing the Seeds Through Science and Engineering Research Act*, establishes the Graduate Scholar Awards in Science, Technology, Engineering, or Mathematics Program at NSF to award graduate fellowships in science, technology, engineering, or mathematics (STEM) to individuals who meet the criteria used in the Foundation's Graduate Research Fellowship Program and who plan to pursue an advanced degree in an area of national need. In addition, the bill directs the Office of Science and

Technology Policy to establish a National Coordination Office for Research Infrastructure to “identify and prioritize deficiencies in research facilities and instrumentation in academic institutions and in national laboratories” and to make recommendations for resource allocation. Introduced on December 16, 2005, H.R.4596 has been referred to multiple committees and subcommittees, most recently the Subcommittee on Domestic and International Monetary Policy, Trade, and Technology of the House Committee on Financial Services. (Sponsor: Representative Bart Gordon/Cosponsors: 7)

H.R.4845 Although many of its provisions are unrelated to education, if enacted, H.R.4845 would have an impact on higher education. According to the bill summary prepared by the Library of Congress, the bill amends the *Higher Education Act of 1965* to replace the Robert C. Byrd Honors Scholarship program with an Innovation Scholarship program and “authorizes the Secretary of Education to: (1) award funds to a private nonprofit organization to administer, through a public-private partnership, a Mathematics and Science Honors Scholarships program for postsecondary and graduate students who commit to five consecutive years of service in a science, engineering, or mathematics field; (2) cover the student loan interest obligations of mathematics, science, or engineering professionals and elementary and secondary school teachers who commit to five consecutive years of service in such positions; and (3) award grants to states to establish, expand, or reform state mathematics and science education coordinating councils where education, business, and community leaders collaborate to improve teacher recruitment and training and student performance in science, technology, engineering, and mathematics.” Introduced on March 2, 2006, H.R.4845 has been referred to the House Committee on the Judiciary, the House Committee on Ways and Means, the House Committee on Science, the House Committee on Education and the Workforce, and the House Committee on Energy and Commerce. (Sponsor: Representative Bob Goodlatte/Cosponsors: 5)

H.R.5356 Titled the *Early Career Research Act*, H.R.5356 authorizes NSF and DOE to award grants of at least $80,000 for up to five years “to scientists and engineers at the early stage of their careers at institutions of higher education and research institutions to conduct research in fields relevant to the mission” of the respective agency. Introduced on May 11, 2006, H.R.5356 has been referred to the House Committee on Science. (Sponsor: Representative Michael T. McCaul/Cosponsors: 9)

H.R.5357 H.R.5357, the *Research for Competitiveness Act*, is similar to H.R.5356 in that it authorizes NSF and DOE to award grants “to scientists and engineers at the early stage of their careers at institutions of higher education and research institutions to conduct research.” It differs from H.R.5356 in that the research to be conducted must be “high-risk, high-return.” In the case of NSF, the research also must be relevant to industry; in the case of DOE, the research must be done in areas relevant to energy production, storage, and use. According to the House Committee on Science press release, NSF and DOE would offer $50,000 grants for up to five years, and make an additional $50,000 available provided the researcher raises one-to-one matching funds from private industry for the proposed research. Introduced on May 11, 2006, H.R.5357 has been referred to the House Committee on Science. (Sponsor: Representative Michael T. McCaul/Cosponsors: 9)

H.R.5358 H.R. 5358, the *Science and Mathematics Education for Competitiveness Act*, increases the minimum award and the allowable years of support under NSF's Robert Noyce Teacher Scholarship Program for undergraduate STEM students who commit to teaching; renames NSF's Math and Science Partnership Program as the Mathematics Teacher Training Partnerships Program and authorizes grants of between $75,000 and $2,000,000 per year to partnerships that include one or more local educational agencies (particularly those considered high-need) and STEM departments at higher education institutions or eligible nonprofit organizations; gradually increases the annual funding for NSF's Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP), which provides grants to institutions of higher education to increase the number of students majoring in STEM; authorizes NSF to award grants to postsecondary departments of science, mathematics, or engineering for the establishment of Centers for Undergraduate Education in Science, Mathematics, and Engineering; ensures that for federal fiscal years 2007 through 2011 at least 1.5 percent of the funds appropriated for NSF Research and Related Activities will be allocated to the Integrative Graduate Education and Research Traineeship Program; requires the NSF Director to assess the impact on students and institutions of the Professional Science Master's degree; and authorizes the Secretary of Energy to carry out education programs and activities in fields related to DOE activities. Introduced on May 11, 2006, H.R.5358 has been referred to the House Committee on Science. (Sponsor: Representative John J.H. "Joe" Schwarz/Cosponsors: 10)

US Senate

S.2109 Based on the recommendations in *Innovate America*, S.2109, the *National Innovation Act of 2005*, doubles the NSF research budget by federal fiscal year 2011, increasing funding for NSF graduate research fellowships and for Professional Science Master's Degree Programs; develops competitive traineeship programs through the Department of Defense; creates Innovation Acceleration Grants to encourage federal agencies that currently fund R&D in science, mathematics, engineering, and technology to devote at least 3.0 percent of their budgets to "projects that meet fundamental technology challenges and that involve multidisciplinary work and a high degree of novelty"; and establishes the President's Council on Innovation to assess and produce annual reports on the performance of federal innovation programs. Introduced on December 15, 2005, S.2109 has been referred to the Senate Committee on Finance. (Sponsor: Senator John Ensign/Cosponsors: Senator Joseph I. Lieberman and 22 others)

On January 3, 2006, an identical bill, H.R.4654, was introduced in the House; it has been referred to multiple committees and subcommittees. The bill, introduced by Representative Adam B. Schiff, has no cosponsors.

Protecting America's Competitive Edge Acts

Collectively referred to as the *Protecting America's Competitive Edge* (PACE) *Acts*, the following three bills, taken together, would enact each of the 20 recommendations in *Rising Above the Gathering Storm* (see Attachment 4 for a section-by-section summary of all three bills). Each of the bills contains one or more provisions affecting education at some level. The *PACE-Energy Act* and the *PACE-Education Act* both support various initiatives to improve K-12 and postsecondary education in science and mathematics, and the *PACE-Finance Act* includes a provision to provide a tax credit for employers who provide continuing education opportunities for their employees.

S.2197 S.2197, the *PACE-Energy Act,* establishes a Director of Mathematics, Science, and Engineering Education within the DOE to oversee the department's education programs in those areas; directs the Secretary of Energy "to offer" to enter into a contract with the National Academy of Sciences to assess the performance of those programs; creates the Mathematics, Science, and Engineering Education Fund; makes funds available to the National Laboratories to allow laboratory staff to teach at "statewide specialty secondary schools that provide comprehensive mathematics and science…education"; establishes summer internships at the National Laboratories for middle and high school students; establishes outreach and experiential-based learning programs to encourage underrepresented minority students in grades K-12 to pursue careers in mathematics, science, and engineering; requires each National Laboratory to support a Center of Excellence in Mathematics and Science at one public high school within its region; funds the appointment of distinguished scientists for six-year terms at the National Laboratories; provides grants to institutions to establish or expand academic degree programs in nuclear science; and provides up to 150 competitive scholarships annually for students who enter into nuclear science programs. Introduced on January 26, 2006, S.2197 was passed by the Senate Committee on Energy and Natural Resources on March 8, 2006, and has been placed on the Senate Calendar for consideration by the full Senate. (Sponsor: Senator Pete V. Domenici/Cosponsors: Senators Jeff Bingaman, Lamar Alexander, Barbara A. Mikulski, and 63 others)

S.2198 In addition to a number of initiatives not related to education, S.2198, the *PACE-Education Act*, contains most of the education initiatives for both K-12 and higher education. Among the bill's many provisions are the following:

- Specifically with regard to education, S.2198 provides grants to universities that develop undergraduate degree programs that integrate math, science, or engineering content with teacher certification and/or master's degree programs in mathematics and science education; establishes NSF scholarships of up to $20,000 per year for four years for students who major in math, science, or engineering with concurrent teacher certification and who commit to teach for five years in a public school; provides an additional $10,000 per year (1) for four years to teachers who complete the program and teach in a high-need school and (2) for five years to teachers who complete the master's degree and assume added responsibilities, such as teacher mentoring; provides funds to expand Advanced Placement or International Baccalaureate (AP-IB) programs and pre-AP-IB programs and authorizes financial incentives for students who pass AP-IB exams, as well as for their teachers; and convenes a national panel to collect proven K-12 math and science teaching materials and creates a clearinghouse for their dissemination.

- S.2198 also creates 25,000 new competitive merit-based Future American-Scientist Scholarships of up to $20,000 per year for four years for students pursuing baccalaureate degrees in mathematics or science and authorizes additional funds for graduate research fellowships in mathematics or science or other areas of national need; creates a new student visa for doctoral candidates in math, engineering, technology, or physical science that would allow students to remain in the United States for as long as one year after the completion of their degree in order to seek employment; exempts foreign scientists from the numerical limitations on employment-based immigrants; and authorizes NSF Early Career Research Grants for individuals who have completed a terminal degree and have shown promise in the field of science, technology, engineering, or mathematics or have equivalent professional experience.

Introduced on January 26, 2006, S.2198 has been heard in the Subcommittee on Education and Early Childhood Development of the Senate Committee on Health, Education, Labor, and Pensions. (Sponsor: Senator Pete V. Domenici/Cosponsors: Senators Jeff Bingaman, Lamar Alexander, Barbara A. Mikulski, and 59 others)

S.2199 S.2199, the *PACE-Finance Act*, doubles the current R&D tax credit from 20 percent to 40 percent; makes the tax credit permanent; expands the credit to cover 100 percent of the cost of all research, not just energy research; directs the Secretary of the Treasury to study additional ways of expanding the credit; creates the Employee Continuing Education Credit for employers who provide continuing education opportunities for employees; and requires the Secretary of the Treasury, in conjunction with the Office of Management and Budget to "conduct an analysis of the United States Tax System and its effect on this country as a location for innovation investment and related activities." Introduced on January 26, 2006, S.2199 currently is in the Senate Committee on Finance. (Sponsor: Senator Pete V. Domenici/Cosponsors: Senators Jeff Bingaman, Lamar Alexander, Barbara A. Mikulski, and 58 others)

Presenter:

Mr. Michael Yudin, Senior Counsel, Senator Jeff Bingaman's Washington Office, will discuss the *PACE Acts*, with particular regard to their impact on education.

Questions the committee may wish to consider:

1. If the *PACE Acts* become law, what will be the impact on public K-12 and postsecondary education in New Mexico?

2. What impact, if any, would passage of the *PACE Acts* have on the reauthorization of the *No Child Left Behind Act of 2001*?

3. What role should New Mexico's National Laboratories play in improving the teaching of science and mathematics in the state's public schools?

4. What is the federal government's role in improving science and mathematics education at all grade levels nationwide?

ATTACHMENT 1

educate
deepen
explore
equip
support
energize
reward
build
invest
attract
create

INNOVATE AMERICA

NATIONAL INNOVATION INITIATIVE SUMMIT AND REPORT

thriving in a world of challenge and change

Council on Competitiveness

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RESOLVED

Innovation will be the single most important factor in determining America's success through the 21st century.

America's Role

The legacy America bequeaths to its children will depend on the creativity and commitment of our nation to lead a new era of prosperity at home and abroad.

America's Challenge

America's challenge is to unleash its innovation capacity to drive productivity, standard of living and leadership in global markets. At a time when macro-economic forces and financial constraints make innovation-driven growth a more urgent imperative than ever before, American businesses, government, workers and universities face an unprecedented acceleration of global change, relentless pressure for short-term results, and fierce competition from countries that seek an innovation-driven future for themselves.

America's Task

For the past 25 years, we have optimized our organizations for efficiency and quality. Over the next quarter century, we must optimize our entire society for innovation.

CALL TO ACTION

Innovate or Abdicate

The National Innovation Initiative™ (NII) defines innovation as the intersection of invention and insight, leading to the creation of social and economic value.

Innovation has always been deep in America's soul. From the nation's birth, we have most fundamentally been about exploration, opportunity and discovery, about new beginnings, about setting out for the frontier.

America's focus on the horizon reflects our collective faith in a better future. These are the qualities that have made our country a beacon to people around the world for the past 228 years. America, in the end, is all about hope. And innovation is the societal and economic manifestation of hope.

Today, America finds itself at a unique and delicate historical juncture, shaped by two unprecedented shifts - one in the nature of global competition, the other in the nature of innovation itself:

1. The world is becoming dramatically more interconnected and competitive. At the same time that economic interdependencies are growing, America is in the unfamiliar position of the world's sole superpower. It is important to recognize how novel this situation is historically, and what opportunities and dangers it holds - from rivals or potential rivals, to be sure, but perhaps even more from how we ourselves choose to handle this geopolitical reality.

2. Where, how and why innovation occurs are in flux - across geography and industries, in speed and scope of impact, and even in terms of who is innovating. In many ways, the playing field is leveling, and the barriers to innovation are falling. Whenever such a shift occurs, there are always changes in how economies and societies work - including new ways of creating value and measuring success, and realignments of competitive advantage. In the 21st century, the pace of these changes will accelerate. To thrive in this new world, it will not be enough - indeed, it will be counterproductive - simply to intensify current stimuli, policies, management strategies and to make incremental improvements to organizational structures and curricula.

Together, these large shifts suggest that we stand at an inflection point in history. Whether one looks at demographics, science, culture, technology, geopolitics, economics or the biological state of the planet, major changes are underway that will shape human society for the next century and beyond. The actions that enterprises, governments, educational institutions, communities, regions and nations take right now will determine this future.

What will America do? Will we plan and invest for the long term, rather than just the next quarter, putting in place the talent pool, innovation capital and infrastructure necessary for continuing success throughout the 21st century? Will we recognize the multifaceted nature of this problem and come together across all sectors - business, government, labor and academia - to form a new social and economic compact?

Perhaps most important is whether the United States will continue its historic and unique role as a leader among nations, exporting the vision and tools of hope and the power of innovation. America must champion and lead a new era of openness and competition - fueled by agility and constant motion, and enabled by lifelong learning, technological prowess and the infinite creativity of the innovation process itself.

We live in tumultuous times, yet Americans know instinctively that our way forward is not to retreat or to re-trench. The way forward is to become more open, more experimental and to embrace the unknown. We cannot turn inward, nor can we allow our institutions to become overly centralized, calcified and risk averse.

If America were a company, freedom and exploration would be our core competencies. And the capacity to innovate is the foundation for bringing our competitiveness into full fruition. The first Americans were innovating when they made the decision to leave an established life for the perils of an unknown world. They were innovating before we had government, a functioning economy, an educational system or national defense. In short, if Americans stop innovating, we stop being Americans.

In the end, the simplest way to describe the purpose of the National Innovation Initiative is to help focus us as a society on what we do best, on our purpose in history. The key to America's future success, finally, is to remember who we are.

Council on Competitiveness Chairman

F. Duane Ackerman
Chairman and Chief Executive Officer
BellSouth

National Innovation Initiative Co-Chairs

Samuel J. Palmisano
Chairman and Chief Executive Officer
IBM Corporation

G. Wayne Clough
President
Georgia Institute of Technology

Gerard J. Arpey
Chairman, Chief Executive Officer and President
AMR and American Airlines

Lee C Bollinger
President
Columbia University

Molly Corbett Broad
President
University of North Carolina

Michael J. Burns
Chairman, President and Chief Executive Officer
Dana Corporation

Mary Sue Coleman
President
University of Michigan

Denis A. Cortese
President and Chief Executive Officer
Mayo Clinic

The Honorable Robert M. Gates
President
Texas A&M University

Sheryl Handler
Chief Executive Officer
Ab Initio

John L. Hennessy
President
Stanford University

The Honorable Shirley Ann Jackson
President
Rensselaer Polytechnic Institute

Vikram Pandit
President and Chief Operating Officer,
Institutional Securities and Investment Banking Group
Morgan Stanley

Steven S Reinemund
Chairman of the Board and Chief Executive Officer
PepsiCo, Inc.

W.J. Sanders III
Founder and Chairman Emeritus
Advanced Micro Devices, Inc

Ivan G. Seidenberg
Chairman and Chief Executive Officer
Verizon

Kevin W. Sharer
Chairman, Chief Executive Officer and President
Amgen, Inc.

Charles M. Vest
President
Massachusetts Institute of Technology

G. Richard Wagoner, Jr.
Chairman and Chief Executive Officer
General Motors Corporation

The Honorable Deborah L. Wince-Smith
President
Council on Competitiveness

EXECUTIVE SUMMARY

The National Innovation Initiative recommendations are organized into three broad categories:

Talent

The human dimension of innovation, including knowledge creation, education, training and workforce support. Recommendations support a culture of collaboration, a symbiotic relationship between research and commercialization, and lifelong skill development.

Investment

The financial dimension of innovation, including R&D investment; support for risk-taking and entrepreneurship; and encouragement of long-term innovation strategies. Recommendations seek to give innovators the resources and incentives to succeed.

Infrastructure

The physical and policy structures that support innovators, including networks for information, transportation, healthcare and energy; intellectual property protection; business regulation; and structures for collaboration among innovation stakeholders. Recommendations support a new industry-academia alliance, an innovation infrastructure for the 21st century, a flexible intellectual property regime, strategies to bolster the nation's manufacturing enterprises, and a national innovation leadership network.

National Innovation Agenda

Talent

Build a **National Innovation Education Strategy** for a diverse, innovative and technically-trained workforce

- Establish tax-deductible private-sector "Invest in the Future" scholarships for American S&E undergraduates
- Empower young American innovators by creating 5,000 new portable graduate fellowships funded by federal R&D agencies
- Expand university-based Professional Science Masters and traineeships to all state university systems
- Reform immigration to attract the best and brightest S&E students from around the world and provide work permits to foreign S&E graduates of U.S. institutions

Catalyze the **Next Generation of American Innovators**

- Stimulate creative thinking and innovation skills through problem-based learning in K-12, community colleges and universities
- Create innovation learning opportunities for students to bridge the gap between research and application
- Establish innovation curricula for entrepreneurs and small business managers

Empower **Workers to Succeed in the Global Economy**

- Stimulate workforce flexibility and skills through lifelong learning opportunities
- Accelerate portability of healthcare and pension benefits
- Align federal and state skills needs more tightly to training resources
- Expand assistance to those dislocated by technology and trade

Investment

Revitalize **Frontier and Multidisciplinary Research**

- Stimulate high-risk research through "Innovation Acceleration" grants that re-allocate 3 percent of agency R&D budgets
- Restore DoD's historic commitment to basic research by directing 20 percent of the S&T budget to long-term research
- Intensify support for physical sciences and engineering to achieve a robust national R&D portfolio
- Enact a permanent, restructured R&E tax credit and extend the credit to research conducted in university-industry consortia

Energize the **Entrepreneurial Economy**

- Build 10 Innovation Hot Spots over the next 5 years to capitalize on regional assets and leverage public-private investments
- Designate a lead agency and an inter-agency council to coordinate federal economic development policies and programs to accelerate innovation-based growth
- Increase the availability of early-stage risk capital with tax incentives, expanded angel networks, and state and private seed capital funds

Reinforce **Risk-Taking and Long-Term Investment**

- Align private-sector incentives and compensation structures to reward long-term value creation
- Create safe-harbor provisions to promote voluntary disclosure of intangible assets
- Reduce the cost of tort litigation from 2 percent to 1 percent of GDP
- Convene a Financial Markets Intermediary Committee to evaluate the impact of new regulations on risk-taking

Infrastructure

Create **National Consensus for Innovation Growth Strategies**

- Enact a federal innovation strategy through the Executive Office of the President
- Catalyze national and regional alliances to implement innovation policies and innovation-led growth
- Develop new metrics to understand and manage innovation more effectively
- Establish National Innovation prizes to recognize excellence in innovation performance

Create a **21st Century Intellectual Property Regime**

- Build quality in all phases of the patent process
- Leverage patent databases into innovation tools
- Create best practices for collaborative standards setting

Strengthen **America's Manufacturing Capacity**

- Create centers for production excellence including shared facilities and consortia
- Foster development of industry-led standards for interoperable manufacturing and logistics
- Create Innovation Extension Centers to enable SMEs to become first-tier manufacturing partners
- Expand industry-led roadmaps for R&D priorities

Build **21st Century Innovation Infrastructures - the health care test bed**

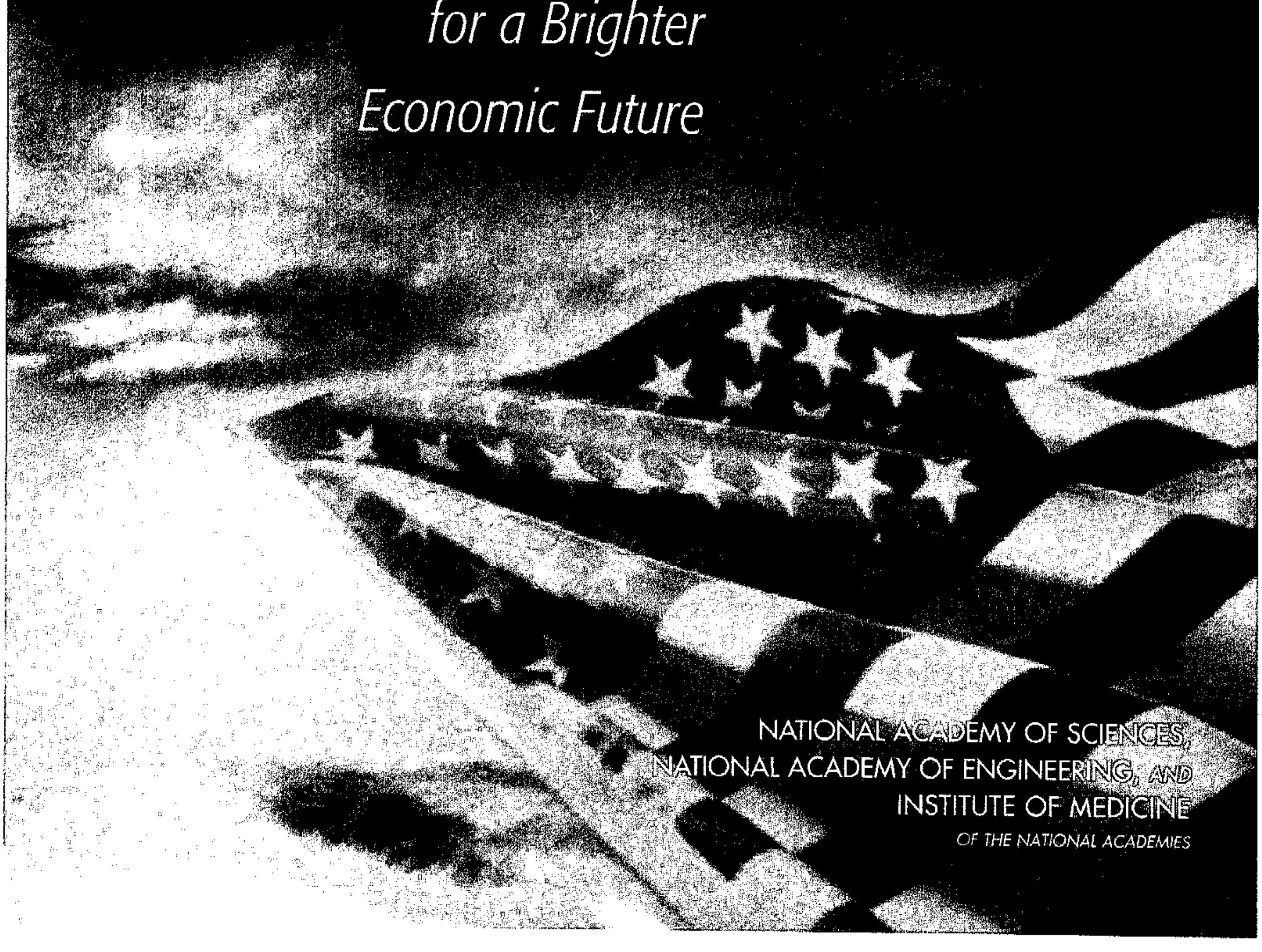
- Expand electronic health reporting
- Establish and promote standards for an integrated health data system
- Establish pilot programs for international electronic exchanges on healthcare research and delivery
- Expand use of performance-based purchasing agreements

EXECUTIVE SUMMARY

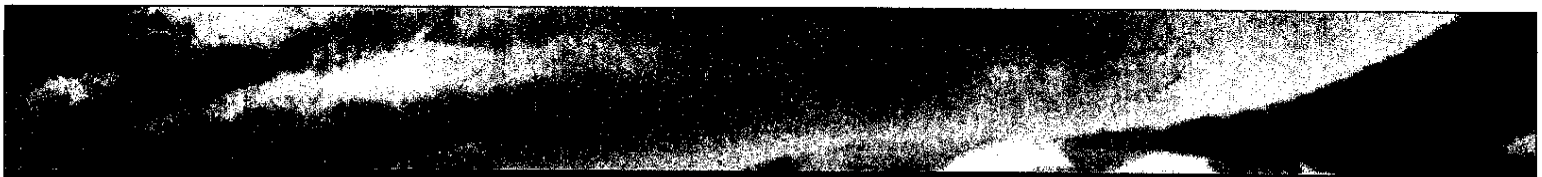
ATTACHMENT 2

RISING ABOVE THE GATHERING STORM

Energizing and Employing America for a Brighter Economic Future



NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, *AND*
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES



COMMITTEE BIOGRAPHIC INFORMATION

NORMAN R. AUGUSTINE [NAE*] (Chair) is the retired chairman and CEO of the Lockheed Martin Corporation. He serves on the President's Council of Advisors on Science and Technology and has served as undersecretary of the Army. He is a recipient of the National Medal of Technology.

CRAIG BARRETT [NAE] is chairman of the Board of the Intel Corporation.

GAIL CASSELL [IOM*] is vice president for scientific affairs and a Distinguished Lilly Research Scholar for Infectious Diseases at Eli Lilly and Company.

STEVEN CHU [NAS*] is the director of the E.O. Lawrence Berkeley National Laboratory. He was a cowinner of the Nobel prize in physics in 1997.

ROBERT GATES is the president of Texas A&M University and served as Director of Central Intelligence.

NANCY GRASMICK is the Maryland state superintendent of schools.

CHARLES HOLLIDAY JR. [NAE] is chairman of the Board and CEO of DuPont.

SHIRLEY ANN JACKSON [NAE] is president of Rensselaer Polytechnic Institute. She is the immediate past president of the American Association for the Advancement of Science and was chairman of the US Nuclear Regulatory Commission.

ANITA K. JONES [NAE] is the Lawrence R. Quarles Professor of Engineering and Applied Science at the University of Virginia. She served as director of defense research and engineering at the US Department of Defense and was vice-chair of the National Science Board.

JOSHUA LEDERBERG [NAS/IOM] is the Sackler Foundation Scholar at Rockefeller University in New York. He was a cowinner of the Nobel prize in physiology or medicine in 1958.

RICHARD LEVIN is president of Yale University and the Frederick William Beinecke Professor of Economics.

C. D. (DAN) MOTE JR. [NAE] is president of the University of Maryland and the Glenn L. Martin Institute Professor of Engineering.

CHERRY MURRAY [NAS/NAE] is the deputy director for science and technology at Lawrence Livermore National Laboratory. She was formerly the senior vice president at Bell Labs, Lucent Technologies.

PETER O'DONNELL JR. is president of the O'Donnell Foundation of Dallas, a private foundation that develops and funds model programs designed to strengthen engineering and science education and research.

LEE R. RAYMOND [NAE] is the chairman of the Board and CEO of Exxon Mobil Corporation.

ROBERT C. RICHARDSON [NAS] is the F. R. Newman Professor of Physics and the vice provost for research at Cornell University. He was a cowinner of the Nobel prize in physics in 1996.

P. ROY VAGELOS [NAS/IOM] is the retired chairman and CEO of Merck & Co., Inc.

CHARLES M. VEST [NAE] is president emeritus of MIT and a professor of mechanical engineering. He serves on the President's Council of Advisors on Science and Technology and is the immediate past chair of the Association of American Universities.

GEORGE M. WHITESIDES [NAS/NAE] is the Woodford L. & Ann A. Flowers University Professor at Harvard University. He has served as an adviser for the National Science Foundation and the Defense Advanced Research Projects Agency.

RICHARD N. ZARE [NAS] is the Marguerite Blake Wilbur Professor of Natural Science at Stanford University. He was chair of the National Science Board from 1996 to 1998.

Principal Project Staff

Deborah D. Stine, Study Director
Tom Arrison, Innovation
David Attis, Research
Laurel Haak, K-12 Education
Peter Henderson, Higher Education
Jo Husbands, National Security

FOR MORE INFORMATION

*This report was developed under the aegis of the National Academies Committee on Science, Engineering, and Public Policy (COSEPUP), a joint committee of the three honorific academies–the National Academy of Sciences [NAS], the National Academy of Engineering [NAE], and the Institute of Medicine [IOM]. Its overall charge is to address cross-cutting issues in science and technology policy that affect the health of the national research enterprise.

More information, including the full body of the report, is available at COSEPUP's Web site, www.nationalacademies.org/cosepup.

NOTE

This report was reviewed in draft form by individuals chosen for their technical expertise, in accordance with procedures approved by the National Academies's Report Review Committee. For a list of those reviewers, refer to the full report.

EXECUTIVE SUMMARY

The United States takes deserved pride in the vitality of its economy, which forms the foundation of our high quality of life, our national security, and our hope that our children and grandchildren will inherit ever-greater opportunities. That vitality is derived in large part from the productivity of well-trained people and the steady stream of scientific and technical innovations they produce. Without high-quality, knowledge-intensive jobs and the innovative enterprises that lead to discovery and new technology, our economy will suffer and our people will face a lower standard of living. Economic studies conducted even before the information-technology revolution have shown that as much as 85% of measured growth in US income per capita was due to technological change.[1]

Today, Americans are feeling the gradual and subtle effects of globalization that challenge the economic and strategic leadership that the United States has enjoyed since World War II. A substantial portion of our workforce finds itself in direct competition for jobs with lower-wage workers around the globe, and leading-edge scientific and engineering work is being accomplished in many parts of the world. Thanks to globalization, driven by modern communications and other advances, workers in virtually every sector must now face competitors who live just a mouse-click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing. This has been aptly referred to as "the Death of Distance."

CHARGE TO THE COMMITTEE

The National Academies was asked by Senator Lamar Alexander and Senator Jeff Bingaman of the Committee on Energy and Natural Resources, with endorsement by Representative Sherwood Boehlert and Representative Bart Gordon of the House Committee on Science, to respond to the following questions:

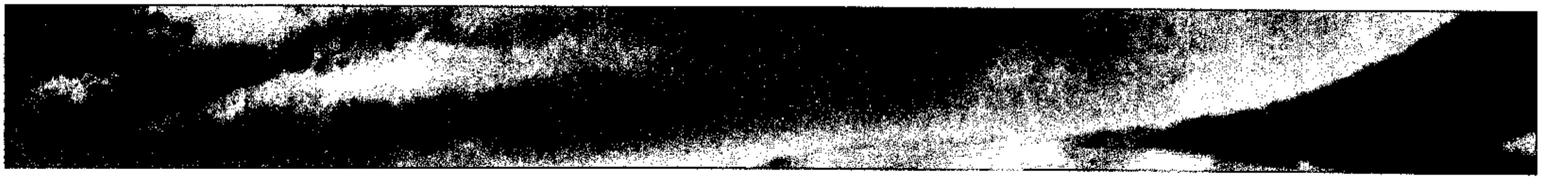
> What are the top 10 actions, in priority order, that federal policymakers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century? What strategy, with several concrete steps, could be used to implement each of those actions?

The National Academies created the Committee on Prospering in the Global Economy of the 21st Century to respond to this request. The charge constitutes a challenge both daunting and exhilarating: to recommend to the nation specific steps that can best strengthen the quality of life in America—our prosperity, our health, and our security. The committee has been cautious in its analysis of information. The available information is only partly adequate for the committee's needs. In addition, the time allotted to develop the report (10 weeks from the time of the committee's first gathering to report release) limited the ability of the committee to conduct an exhaustive analysis. Even if unlimited time were available, definitive analyses on many issues are not possible given the uncertainties involved.[2]

This report reflects the consensus views and judgment of the committee members. Although the committee consists of leaders in academe, industry, and government—including several current and former industry chief executive officers, university presidents, researchers (including three Nobel prize winners), and former presidential appointees—the array of topics and policies covered is so broad that it was not possible to assemble a committee of 20 members with direct expertise in each relevant area. Because of those limitations, the committee has relied heavily on the judgment of many experts in the study's focus groups, additional consultations via e-mail and telephone with other experts, and an unusually large panel of reviewers. Although other solutions are undoubtedly possible, the committee believes that its recommendations, if implemented, will help the United States achieve prosperity in the 21st century.

[1]For example, work by Robert Solow and Moses Abramovitz published in the middle 1950s demonstrated that as much as 85% of measured growth in US income per capita during the 1890-1950 period could not be explained by increases in the capital stock or other measurable inputs. The unexplained portion, referred to alternatively as the "residual" or "the measure of ignorance," has been widely attributed to the effects of technological change.

[2]Since the prepublication version of the report was released in October, certain changes have been made to correct editorial and factual errors, add relevant examples and indicators, and ensure consistency among sections of the report. Although modifications have been made to the text, the recommendations remain unchanged, except for a few corrections, which have been footnoted.



FINDINGS

Having reviewed trends in the United States and abroad, the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength. We strongly believe that a worldwide strengthening will benefit the world's economy—particularly in the creation of jobs in countries that are far less well-off than the United States. But we are worried about the future prosperity of the United States. Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and ideas exist throughout the world. We fear the abruptness with which a lead in science and technology can be lost—and the difficulty of recovering a lead once lost, if indeed it can be regained at all.

The committee found that multinational companies use criteria[3] such as the following in determining where to locate their facilities and the jobs that result:

- Cost of labor (professional and general workforce).
- Availability and cost of capital.
- Availability and quality of research and innovation talent.
- Availability of qualified workforce.
- Taxation environment.
- Indirect costs (litigation, employee benefits such as healthcare, pensions, vacations).
- Quality of research universities.
- Convenience of transportation and communication (including language).
- Fraction of national research and development supported by government.
- Legal-judicial system (business integrity, property rights, contract sanctity, patent protection).
- Current and potential growth of domestic market.
- Attractiveness as place to live for employees.
- Effectiveness of national economic system.

Although the US economy is doing well today, current trends in each of these areas indicate that the United States may not fare as well in the future without government intervention. This nation must prepare with great urgency to preserve its strategic and economic security. Because other nations have, and probably will continue to have, the competitive advantage of a low wage structure, the United States must compete by optimizing its knowledge-based resources, particularly in science and technology, and by sustaining the most fertile environment for new and revitalized industries and the well-paying jobs they bring. We have already seen that capital, factories, and laboratories readily move wherever they are thought to have the greatest promise of return to investors.

RECOMMENDATIONS

The committee reviewed hundreds of detailed suggestions—including various calls for novel and untested mechanisms—from other committees, from its focus groups, and from its own members. The challenge is immense, and the actions needed to respond are immense as well.

The committee identified two key challenges that are tightly coupled to scientific and engineering prowess: creating high-quality jobs for Americans, and responding to the nation's need for clean, affordable, and reliable energy. To address those challenges, the committee structured its ideas according to four basic recommendations that focus on the human, financial, and knowledge capital necessary for US prosperity.

The four recommendations focus on actions in K–12 education (*10,000 Teachers, 10 Million Minds*), research (*Sowing the Seeds*), higher education (*Best and Brightest*), and economic policy (*Incentives for Innovation*) that are set forth in the following sections. Also provided are a total of 20 implementation steps for reaching the goals set forth in the recommendations.

Some actions involve changes in the law. Others require financial support that would come from reallocation of existing funds or, if necessary, from new funds. Overall, the committee believes that the investments are modest relative to the magnitude of the return the nation can expect in the creation of new high-quality jobs and in responding to its energy needs.

The committee notes that the nation is unlikely to receive some sudden "wake-up" call; rather, the problem is one that is likely to evidence itself gradually over a surprisingly short period.

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[3] D.H. Dalton, M.G. Serapio, Jr., P.G. Yoshida. 1999. Globalizing Industrial Research and Development. US Department of Commerce, Technology Administration, Office of Technology Policy. Grant Gross. 2003, October 9. "CEOs defend moving jobs offshore at tech summit." InfoWorld. Mehlman, Bruce. 2003. Offshore Outsourcing and the Future of American Competitiveness. "High tech in China: is it a threat to Silicon Valley?" 2002, October 28. Business Week online. B. Callan, S. Costigan, K. Keller. 1997. Exporting U.S. High Tech: Facts and Fiction about the Globalization of Industrial R&D, Council on Foreign Relations, New York, NY.

10,000 TEACHERS, 10 MILLION MINDS, AND K-12 SCIENCE AND MATHEMATICS EDUCATION

RECOMMENDATION A: ***Increase America's talent pool by vastly improving K–12 science and mathematics education.***

Implementation Actions

The highest priority should be assigned to the following actions and programs. All should be subjected to continuing evaluation and refinement as they are implemented.

Action A-1: Annually recruit 10,000 science and mathematics teachers by awarding 4-year scholarships and thereby educating 10 million minds. Attract 10,000 of America's brightest students to the teaching profession every year, each of whom can have an impact on 1,000 students over the course of their careers. The program would award competitive 4-year scholarships for students to obtain bachelor's degrees in the physical or life sciences, engineering, or mathematics with concurrent certification as K–12 science and mathematics teachers. The merit-based scholarships would provide up to $20,000 a year for 4 years for qualified educational expenses, including tuition and fees, and require a commitment to 5 years of service in public K–12 schools. A $10,000 annual bonus would go to participating teachers in underserved schools in inner cities and rural areas. To provide the highest-quality education for undergraduates who want to become teachers, it would be important to award matching grants, on a one-to-one basis, of $1 million a year for up to 5 years, to as many as 100 universities and colleges to encourage them to establish integrated 4-year undergraduate programs leading to bachelor's degrees in the physical and life sciences, mathematics, computer sciences, or engineering *with teacher certification.* The models for this action are UTeach at the University of Texas and California Teach at the University of California.

Action A-2: Strengthen the skills of 250,000 teachers through training and education programs at summer institutes, in master's programs, and in Advanced Placement (AP) and International Baccalaureate (IB) training programs. Use proven models to strengthen the skills (and compensation, which is based on education and skill level) of 250,000 *current* K–12 teachers.

- *Summer institutes:* Provide matching grants to state and regional 1- to 2-week summer institutes to upgrade the skills and state-of-the-art knowledge of as many as 50,000 practicing teachers each summer. The material covered would allow teachers to keep current with recent developments in science, mathematics, and technology and allow for the exchange of best teaching practices. The Merck Institute for Science Education is one model for this action.

- *Science and mathematics master's programs:* Provide grants to research universities to offer, over 5 years, 50,000 current middle school and high school science, mathematics, and technology teachers (with or without undergraduate science, mathematics, or engineering degrees) 2-year, part-time master's degree programs that focus on rigorous science and mathematics content and pedagogy. The model for this action is the University of Pennsylvania Science Teachers Institute.

- *AP, IB, and pre-AP or pre-IB training:* Train an additional 70,000 AP or IB and 80,000 pre-AP or pre-IB instructors to teach advanced courses in science and mathematics. Assuming satisfactory performance, teachers may receive incentive payments of $1,800 per year, as well as $100 for each student who passes an AP or IB exam in mathematics or science. There are two models for this program: the Advanced Placement Incentive Program and Laying the Foundation, a pre-AP program.

- *K–12 curriculum materials modeled on a world-class standard:* Foster high-quality teaching with world-class curricula, standards, and assessments of student learning. Convene a national panel to collect, evaluate, and develop rigorous K–12 materials that would be available free of charge as a *voluntary* national curriculum. The model for this action is the Project Lead the Way pre-engineering courseware.

Action A-3: Enlarge the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, or mathematics by increasing the number of students who pass AP and IB science and mathematics courses. Create opportunities and incentives for middle school and high school students to pursue advanced work in science and mathematics. By 2010, increase the number of students who take at least one AP or IB mathematics or science exam to 1.5 million, and set a goal of tripling the number who pass those tests to 700,000.[4] Student incentives for success would include 50% examination fee rebates and $100 mini-scholarships for each passing score on an AP or IB science or mathematics examination.

Although not included among its implementation actions, the committee also finds attractive the expansion of two approaches to improving K–12 science and mathematics education that are already in use:

- *Statewide specialty high schools:* Specialty secondary education can foster leaders in science, technology, and mathematics. Specialty schools immerse students in high-quality science, technology, and mathematics education; serve as a mechanism to test teaching materials; provide a training ground for K–12 teachers; and provide the resources and staff for summer programs that introduce students to science and mathematics.

- *Inquiry-based learning:* Summer internships and research opportunities provide especially valuable laboratory experience for both middle school and high school students.

[4]This sentence was incorrectly phrased in the original October 12, 2005 edition of the Executive Summary and has now been corrected.

[5]The funds may come from anywhere in government, not just other research funds.

SOWING THE SEEDS THROUGH SCIENCE AND ENGINEERING RESEARCH

RECOMMENDATION B: ***Sustain and strengthen the nation's traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life.***

Implementation Actions

Action B-1: Increase the federal investment in long-term basic research by 10% each year over the next 7 years through reallocation of existing funds[5] or, if necessary, through the investment of new funds. Special attention should go to the physical sciences, engineering, mathematics, and information sciences and to Department of Defense (DoD) basic-research funding. This special attention does not mean that there should be a disinvestment in such important fields as the life sciences or the social sciences. A balanced research portfolio in all fields of science and engineering research is critical to US prosperity. Increasingly, the most significant new scientific and engineering advances are formed to cut across several disciplines. This investment should be evaluated regularly to realign the research portfolio to satisfy emerging needs and promises—unsuccessful projects and venues of research should be replaced with research projects and venues that have greater potential.

Action B-2: Provide new research grants of $500,000 each annually, payable over 5 years, to 200 of the nation's most outstanding *early-career* researchers. The grants would be made through existing federal research agencies—the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Energy (DoE), DoD, and the National Aeronautics and Space Administration (NASA)—to underwrite new research opportunities at universities and government laboratories.

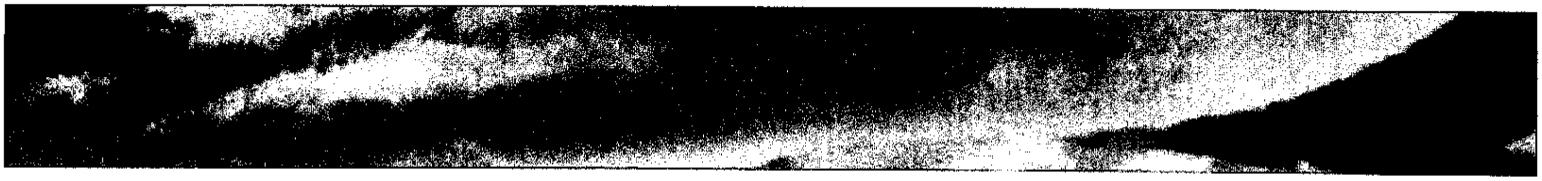
Action B-3: Institute a National Coordination Office for Advanced Research Instrumentation and Facilities to manage a fund of $500 million in incremental funds per year over the next 5 years—through reallocation of existing funds or, if necessary, through the investment of new funds—to ensure that universities and government laboratories create and maintain the facilities, instrumentation, and equipment needed for leading-edge scientific discovery and technological development. Universities and national laboratories would compete annually for these funds.

Action B-4: Allocate at least 8% of the budgets of federal research agencies to discretionary funding that would be managed by technical program managers in the agencies and be focused on catalyzing high-risk, high-payoff research of the type that often suffers in today's increasingly risk-averse environment.

Action B-5: Create in the Department of Energy an organization like the Defense Advanced Research Projects Agency (DARPA) called the Advanced Research Projects Agency-Energy (ARPA-E).[6] The director of ARPA-E would report to the under secretary for science and would be charged with sponsoring specific research and development programs to meet the nation's long-term energy challenges. The new agency would support creative "out-of-the-box" transformational generic energy research that industry by itself cannot or will not support and in which risk may be high but success would provide dramatic benefits for the nation. This would accelerate the process by which knowledge obtained through research is transformed to create jobs and address environmental, energy, and security issues. ARPA-E would be based on the historically successful DARPA model and would be designed as a lean and agile organization with a great deal of independence that can start and stop targeted programs on the basis of performance and do so in a timely manner. The agency would itself perform no research or transitional effort but would fund such work conducted by universities, startups, established firms, and others. Its staff would turn over approximately every 4 years. Although the agency would be focused on specific energy issues, it is expected that its work (like that of DARPA or NIH) will have important spinoff benefits, including aiding in the education of the next generation of researchers. Funding for ARPA-E would start at $300 million the first year and increase to $1 billion per year over 5-6 years, at which point the program's effectiveness would be evaluated and any appropriate actions taken.

Action B-6: Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest. Existing presidential awards recognize lifetime achievements or promising young scholars, but the proposed new awards would identify and recognize persons who develop unique scientific and engineering innovations in the national interest at the time they occur.

[6]One committee member, Lee Raymond, does not support this action item. He does not believe that ARPA-E is necessary as energy research is already well funded by the federal government, along with formidable funding of energy research by the private sector. Also, ARPA-E would, in his view, put the federal government in the business of picking "winning energy technologies"—a role best left to the private sector.



BEST AND BRIGHTEST IN SCIENCE AND ENGINEERING HIGHER EDUCATION

RECOMMENDATION C: ***Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world.***

Implementation Actions

Action C-1: Increase the number and proportion of US citizens who earn bachelor's degree in the physical sciences, the life sciences, engineering, and mathematics by providing 25,000 new 4-year competitive undergraduate scholarships each year to US citizens attending US institutions. The Undergraduate Scholar Awards in Science, Technology, Engineering, and Mathematics (USA-STEM) would be distributed to states on the basis of the size of their congressional delegations and awarded on the basis of national examinations. An award would provide up to $20,000 annually for tuition and fees.

Action C-2: Increase the number of US citizens pursuing graduate study in "areas of national need" by funding 5,000 new graduate fellowships each year. NSF should administer the program and draw on the advice of other federal research agencies to define national needs. The focus on national needs is important both to ensure an adequate supply of doctoral scientists and engineers and to ensure that there are appropriate employment opportunities for students once they receive their degrees. Portable fellowships would provide a stipend of $30,000[7] annually directly to students, who would choose where to pursue graduate studies instead of being required to follow faculty research grants, and up to $20,000 annually for tuition and fees.

[7] An incorrect number was provided for the graduate student stipend in the original October 12, 2005 edition of the Executive Summary and has now been corrected.

Action C-3: Provide a federal tax credit to encourage employers to make continuing education available (either internally or though colleges and universities) to practicing scientists and engineers. These incentives would promote career-long learning to keep the workforce productive in an environment of rapidly evolving scientific and engineering discoveries and technological advances and would allow for retraining to meet new demands of the job market.

Action C-4: Continue to improve visa processing for international students and scholars to provide less complex procedures and continue to make improvements on such issues as visa categories and duration, travel for scientific meetings, the technology alert list, reciprocity agreements, and changes in status.

Action C-5: Provide a 1-year automatic visa extension to international students who receive doctorates or the equivalent in science, technology, engineering, mathematics, or other fields of national need at qualified US institutions to remain in the United States to seek employment. If these students are offered jobs by US-based employers and pass a security screening test, they should be provided automatic work permits and expedited residence status. If students are unable to obtain employment within 1 year, their visas would expire.

Action C-6: Institute a new skills-based, preferential immigration option. Doctoral-level education and science and engineering skills would substantially raise an applicant's chances and priority in obtaining US citizenship. In the interim, the number of H-1B visas should be increase by 10,000, and the additional visas should be available for industry to hire science and engineering applicants with doctorates from US universities.[8]

[8] Since the report was released, the committee has learned that the Consolidated Appropriations Act of 2005, signed into law on December 8, 2004, exempts individuals that have received a master's or higher education degree from a US university from the statutory cap (up to 20,000). The bill also raised the H-1B fee and allocated funds to train American workers. The committee believes that this provision is sufficient to respond to its recommendation—even though the 10,000 additional visas recommended is specifically for science and engineering doctoral candidates from US universities, which is a narrower subgroup.

Action C-7: Reform the current system of "deemed exports". The new system should provide international students and researchers engaged in fundamental research in the United States with access to information and research equipment in US industrial, academic, and national laboratories comparable with the access provided to US citizens and permanent residents in a similar status. It would, of course, exclude information and facilities restricted under national-security regulations. In addition, the effect of deemed-exports[9] regulations on the education and fundamental research work of international students and scholars should be limited by removing from the deemed-exports technology list all technology items (information and equipment) that are available for purchase on the overseas open market from foreign or US companies or that have manuals that are available in the public domain, in libraries, over the Internet, or from manufacturers.

[9]The controls governed by the Export Administration Act and its implementing regulations extend to the transfer of technology. Technology includes "specific information necessary for the 'development,' 'production,' or 'use' of a product". Providing information that is subject to export controls—for example, about some kinds of computer hardware—to a foreign national within the United States may be "deemed" an export, and that transfer requires an export license. The primary responsibility for administering controls on deemed exports lies with the Department of Commerce, but other agencies have regulatory authority as well.

INCENTIVES FOR INNOVATION

Recommendation D: Ensure that the United States is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marketing; and create high-paying jobs based on innovation by such actions as modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access.

Implementation Actions

Action D-1: Enhance intellectual-property protection for the 21st-century global economy to ensure that systems for protecting patents and other forms of intellectual property underlie the emerging knowledge economy but allow research to enhance innovation. The patent system requires reform of four specific kinds:

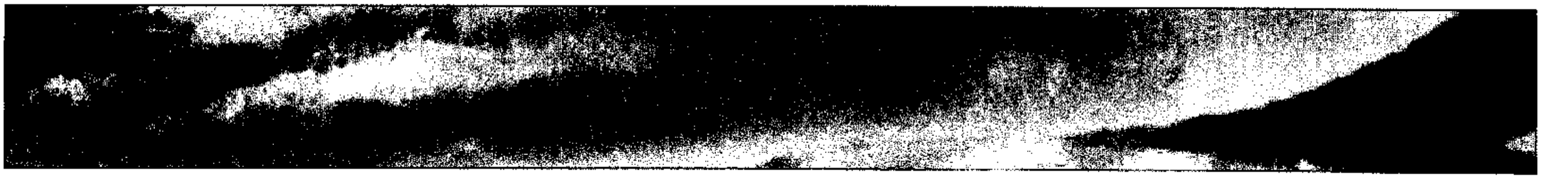
- Provide the US Patent and Trademark Office with sufficient resources to make intellectual-property protection more timely, predictable, and effective.

- Reconfigure the US patent system by switching to a "first-inventor-to-file" system and by instituting administrative review *after* a patent is granted. Those reforms would bring the US system into alignment with patent systems in Europe and Japan.

- Shield research uses of patented inventions from infringement liability. One recent court decision could jeopardize the long-assumed ability of academic researchers to use patented inventions for research.

- Change intellectual-property laws that act as barriers to innovation in specific industries, such as those related to data exclusivity (in pharmaceuticals) and those that increase the volume and unpredictability of litigation (especially in information-technology industries).

Action D-2: Enact a stronger research and development tax credit to encourage private investment in innovation. The current Research and Experimentation Tax Credit goes to companies that *increase* their research and development spending above a base amount calculated from their spending in prior years. Congress and the



Administration should make the credit permanent,[10] and it should be increased from 20% to 40% of the qualifying increase so that the US tax credit is competitive with those of other countries. The credit should be extended to companies that have consistently spent large amounts on research and development so that they will not be subject to the current *de facto* penalties for having previously invested in research and development.

Action D-3: Provide tax incentives for US-based innovation. Many policies and programs affect innovation and the nation's ability to profit from it. It was not possible for the committee to conduct an exhaustive examination, but alternatives to current economic policies should be examined and, if deemed beneficial to the United States, pursued. These alternatives could include changes in overall corporate tax rates and special tax provisions providing the purchase of high-technology research and manufacturing equipment, treatment of capital gains, and incentives for long-term investments in innovation. The Council of Economic Advisers and the Congressional Budget Office should conduct a comprehensive analysis to examine how the United States compares with other nations as a location for innovation and related activities with a view to ensuring that the United States is one of the most attractive places in the world for long-term innovation-related investment and the jobs resulting from that investment. From a tax standpoint, that is not now the case.

Action D-4: Ensure ubiquitous broadband Internet access. Several nations are well ahead of the United States in providing broadband access for home, school, and business. That capability can be expected to do as much to drive innovation, the economy, and job creation in the 21st century as did access to the telephone, interstate highways, and air travel in the 20th century. Congress and the Administration should take action—mainly in the regulatory arena and in spectrum management—to ensure widespread affordable broadband access in the very near future.

CONCLUSION

The committee believes that its recommendations and the actions proposed to implement them merit serious consideration if we are to ensure that our nation continues to enjoy the jobs, security, and high standard of living that this and previous generations worked so hard to create. Although the committee was asked only to recommend actions that can be taken by the federal government, it is clear that related actions at the state and local levels are equally important for US prosperity, as are actions taken by each American family. The United States faces an enormous challenge because of the disparity it faces in labor costs. Science and technology provide the opportunity to overcome that disparity by creating scientists and engineers with the ability to create entire new industries—much as has been done in the past.

It is easy to be complacent about US competitiveness and preeminence in science and technology. We have led the world for decades, and we continue to do so in many research fields today. But the world is changing rapidly, and our advantages are no longer unique. Some will argue that this is a problem for market forces to resolve—but that is exactly the concern. Market forces are *already at work* moving jobs to countries with less costly, often better educated, highly motivated work forces and more friendly tax policies.

Without a renewed effort to bolster the foundations of our competitiveness, we can expect to lose our privileged position. For the first time in generations, the nation's children could face poorer prospects than their parents and grandparents did. We owe our current prosperity, security, and good health to the investments of past generations, and we are obliged to renew those commitments in education, research, and innovation policies to ensure that the American people continue to benefit from the remarkable opportunities provided by the rapid development of the global economy and its not inconsiderable underpinning in science and technology.

[10] The previous R&D tax credit expired in December 2005.

SOME COMPETITIVENESS INDICATORS

US ECONOMY

- The United States is today a net importer of *high-technology* products. Its trade balance in high-technology manufactured goods shifted from *plus* $54 billion in 1990 to *negative* $50 billion in 2001.[1]

- In one recent period, low-wage employers, such as Wal-Mart (now the nation's largest employer) and McDonald's, created 44% of the new jobs while high-wage employers created only 29% of the new jobs.[2]

- The United States is one of the few countries in which industry plays a major role in providing health care for its employees and their families. Starbucks spends more on healthcare than on coffee. General Motors spends more on health care than on steel.[3]

- US scheduled airlines currently outsource portions of their aircraft maintenance to China and El Salvador.[4]

- IBM recently sold its personal computer business to an entity in China.[5]

- Ford and General Motors both have junk bond ratings.[6]

- It has been estimated that within a decade nearly 80% of the world's middle-income consumers would live in nations outside the currently industrialized world. China alone could have 595 million middle-income consumers and 82 million upper-middle-income consumers. The total population of the United States is currently 300 million and is projected to be 315 million in a decade.[7]

- Some economists estimate that about half of US economic growth since World War II has been the result of technological innovation.[8]

- In 2005, American investors put more new money in foreign stock funds than in domestic stock portfolios.[9]

COMPARATIVE ECONOMICS

- Chemical companies closed 70 facilities in the United States in 2004 and tagged 40 more for shutdown. Of 120 chemical plants being built around the world with price tags of $1 billion or more, one is in the United States and 50 are in China. No new refineries have been built in the United States since 1976.[10]

- The United States is said to have 7 million illegal immigrants,[11] but under the law the number of visas set aside for "highly qualified foreign workers," many of whom contribute significantly to the nation's innovations, dropped to 65,000 a year from its 195,000 peak.[12]

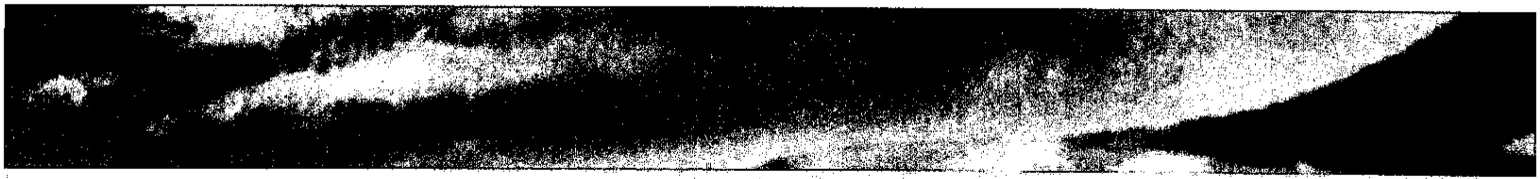
- When asked in Spring 2005 what is the most attractive place in the world in which to "lead a good life", respondents in only one (India) of the 16 countries polled indicated the United States.[13]

- A company can hire nine factory workers in Mexico for the cost of one in America. A company can hire eight young professional engineers in India for the cost of one in America.[14]

- The share of leading-edge semiconductor manufacturing capacity owned or partly owned by US companies today is half what it was as recently as 2001.[15]

- During 2004, China overtook the United States to become the leading exporter of information-technology products, according to the OECD.[16]

- The United States ranks only 12th among OECD countries in the number of broadband connections per 100 inhabitants.[17]



K-12 EDUCATION

- Fewer than one-third of US 4th-grade and 8th-grade students performed at or above a level called "proficient" in mathematics; "proficiency" was considered the ability to exhibit competence with challenging subject matter. Alarmingly, about one-third of the 4th graders and one-fifth of the 8th graders lacked the competence to perform even basic mathematical computations.[18]

- In 1999, 68% of US 8th grade students received instruction from a mathematics teacher who did not hold a degree or certification in mathematics.[19]

- In 2000, 93% of students in grades 5-9 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics).[20]

- In 1995 (the most recent data available), US 12th graders performed below the international average for 21 countries on a test of general knowledge in mathematics and science.[21]

- US 15-year-olds ranked 24th out of 40 countries that participated in a 2003 administration of the Program for International Student Assessment (PISA) examination, which assessed students' ability to apply mathematical concepts to real-world problems.[22]

- According to a recent survey, 86% of US voters believe that the United States must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.[23]

- American youth spend more time watching television[24] than in school.[25]

- Because the United States does not have a set of national curricula, changing K-12 education is challenging, given that there are almost 15,000 school systems in the United States and the average district has only about 6 schools.[26]

HIGHER EDUCATION

- In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50%, and in Singapore 67%. In the United States, the corresponding figure is 15%.[27]

- Some 34% percent of doctoral degrees in natural sciences (including the physical, biological, earth, ocean, and atmospheric sciences) and 56% of engineering PhDs in the United States are awarded to foreign-born students.[28]

- In the US science and technology workforce in 2000, 38% of PhDs were foreign-born.[29]

- Estimates of the number of engineers, computer scientists, and information technology students who obtain 2-, 3-, or 4-year degrees vary. One estimate is that in 2004, China graduated about 350,000 engineers, computer scientists, and information technologists with 4-year degrees, while the United States graduated about 140,000. China also graduated about 290,000 with 3-year degrees in these same fields, while the United States graduated about 85,000 with 2- or 3-year degrees.[30] Over the past 3 years alone, both China[31] and India[32] have doubled their production of 3- and 4-year degrees in these fields, while the US[33] production of engineers is stagnant and the rate of production of computer scientists and information technologists doubled.

- About one-third of US students intending to major in engineering switch majors before graduating.[34]

- There were almost twice as many US physics bachelor's degrees awarded as in 1956, the last graduating class before Sputnik than in 2004.[35]

- More S&P 500 CEOs obtained their undergraduate degrees in engineering than in any other field.[36]

RESEARCH

- In 2001 (the most recent year for which data are available), US industry spent more on tort litigation than on research and development.[37]

- In 2005, only four American companies ranked among the top 10 corporate recipients of patents granted by the *United States* Patent and Trademark Office.[38]

- Beginning in 2007, the most capable high-energy particle accelerator on Earth will, for the first time, reside outside the United States.[39]

- Federal funding of research in the physical sciences, as a percentage of GDP, was 45% less in FY 2004 than in FY 1976.[40] The amount invested annually by the US federal government in research in the physical sciences, mathematics, and engineering combined equals the annual increase in US health care costs incurred every 20 days.[41]

PERSPECTIVES

- "We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next 10 years." –Intel spokesman Howard High[42]

- "If we don't step up to the challenge of finding and supporting the best teachers, we'll undermine everything else we are trying to do to improve our schools."—Louis V. Gerstner, Jr., Former Chairman, IBM[43]

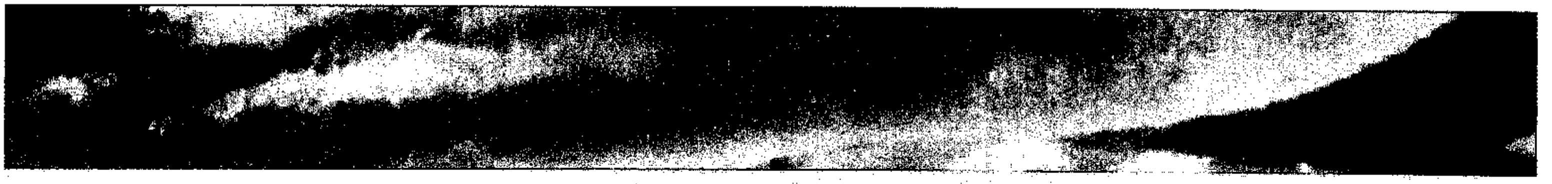
- "If you want good manufacturing jobs, one thing you could do is graduate more engineers. We had more sports exercise majors graduate than electrical engineering grads last year." —Jeffrey R. Immelt, Chairman and Chief Executive Office, General Electric[44]

- "If I take the revenue in January and look again in December of that year 90% of my December revenue comes from products which were not there in January." – Craig Barrett, Chairman of the Intel Corporation[45]

- "When I compare our high schools to what I see when I'm traveling abroad, I am terrified for our workforce of tomorrow." –Bill Gates, Chairman and Chief Software Architect of Microsoft Corporation[46]

- "Where once nations measured their strength by the size of their armies and arsenals, in the world of the future knowledge will matter most." –President Bill Clinton [47]

- "Science and technology have never been more essential to the defense of the nation and the health of our economy."—President George W. Bush[48]



NOTES for SOME COMPETITIVENESS INDICATORS and PERSPECTIVES:

[1]For 2001, the dollar value of high-technology imports was $561 billion; the value of high-technology exports was $511 billion. See National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA. National Science Foundation. Appendix Table 6-01. Page A6-5 provides the export numbers for 1990 and 2001 and page A6-6 has the import numbers.

[2]Steve Roach. More Jobs, Worse Work. New York Times. July 22, 2004.

[3]Chris Noon. 2005. "Starbuck's Schultz Bemoans Health Care Costs." Forbes.com, September 19.Available at:http://www.forbes.com/facesinthenews/2005/09/15/starbuckshealthcarebenefitscx_cn_0915autofacescan01.html?partner=yahooti; Ron Scherer. 2005. "Rising Benefits Burden." Christian Science Monitor, June 9. Available at: http://www.csmonitor.com/2005/0609/p01s01-usec.html.

[4]Sara Kehaulani Goo. Airlines Outsource Upkeep. Washington Post. August 21, 2005. Available at: http://www.washingtonpost.com/wp-dyn/content/article/2005/08/20/AR2005082000979.html. Sara Kehaulani Goo. Two-Way Traffic in Airplane Repair. Washington Post, June 1, 2004. Available at http://www.washingtonpost.com/wp-dyn/articles/A5138-2004 May31.html.

[5]Michael Kanellos. 2004. "IBM Sells PC Group to Lenovo." News.com, December 8. Available at: http://news.com.com/IBM+sells+PC+group+to+Lenovo/2100-1042_3-5482284.html.

[6]http://www.nytimes.com/2005/05/05/business/05cnd-auto.html?ex=1137128400 &en=ac63687768634c6d&ei=5070.

[7]For China, see Paul A. Laudicina, 2005. World Out of Balance: Navigating Global Risks to Seize Competitive Advantage. New York: McGraw Hill, p. 76. For the United States, see US Census Bureau. US. Population Clock. Available at www.census.gov for current population and for the projected population, see Population Projections Program, Population Division, U.S. Census Bureau. Population Projections of the United States by Age, Sex, Race, Hispanic Origin, and Nativity: 1999 to 2100. Washington, D.C. January 13, 2000. Available at: http://www.census.gov/population/www/projections/natsum-T3.html.

[8]Michael J. Boskin and Lawrence J. Lau. 1992. Capital, Technology, and Economic Growth. In Nathan Rosenberg, Ralph Landau, and David C. Mowery, eds. Technology and the Wealth of Nations: Stanford University Press: Stanford, CA.

[9]Paul J. Lim. Looking Ahead Means Looking Abroad. New York Times. January 8th 2006.

[10]Michael Arndt. 2005. "No Longer the Lab of the World: U.S. Chemical Plants are Closing in Droves as Production Heads Abroad." BusinessWeek, May 2. Available at: http://www.businessweek.com/magazine/content/05_18/b3931106.htm and http://www.usnews.com/usnews/biztech/articles/051010/10energy.htm.

[11]As of 2000, the unauthorized resident population in the United States was 7 million. See US Citizenship and Immigration Services. 2003. "Executive Summary: Estimates of the Unauthorized Immigrant Population Residing in the United States: 1990 to 2000." January 31. Available at: http://uscis.gov/graphics/shared/statistics/publications/2000ExecSumm.pdf.

[12]Section 214(g) of the Immigration and Nationality Act (Act) sets an annual limit on the number of aliens that can receive H-1B status in a fiscal year. For FY2000 the limit was set at 115,000. The American Competitiveness in the Twenty-First Century Act increased the annual limit to 195,000 for 2001, 2002, and 2003. After that date the cap reverts back to 65,000. H-1B visas allow employers to have access to highly educated foreign professionals who have experience in specialized fields and who have at least a bachelor's degree or the equivalent. The cap does not apply to educational institutions. In November 2004, Congress created an exemption for 20,000 foreign nationals earning advanced degrees from US universities. See Immigration and Nationality Act Section 101(a)(15)(h)(1)(b). See US Citizenship and Immigration Services. 2005. "Public Notice: "USCIS Announces Update Regarding New H-1B Exemptions" July 12. Available at: http://uscis.gov/graphics/publicaffairs/newsrels/H1B_06Cap_011806PR.pdf. and US Citizenship and Immigration Services. 2000. "Questions and Answers: Changes to the H-1B Program" November 21. Available at: http://uscis.gov/graphics/publicaffairs/questsans/H1BChang.htm.

[13]Pew Research Center. 2005 "U.S. Image Up Slightly, But Still Negative, American Character Gets Mixed Reviews" Pew Global Attitudes Project. Washington, DC. Available at: http://pewglobal.org/reports/display.php?ReportID=247 The interview asked nearly 17,000 people the question: "Suppose a young person who wanted to leave this country asked you to recommend where to go to lead a good life–what country would you recommend?" Except for respondents in India, Poland, and Canada, no more than one-tenth of the people in the other nations said they would recommend the United States. Canada and Australia won the popularity contest.

[14]United States Bureau of Labor Statistics. 2005. International Comparisons of Hourly Compensation Costs for Production Workers in Manufacturing, 2004. November 18. Available at: ftp://ftp.bls.gov/pub/news.release/History/ichcc.11182005.news.

[15]Semiconductor Industry Association. 2005. "Choosing to Compete." December 12. Available at: http://www.sia-online.org/downloads/FAD%20'05%20-%20Scalise%20Presentation.pdf.

[16]OECD. 2005. "China Overtakes U.S. As World's Leading Exporter of Information Technology Goods." December 12. Available at: http://www.oecd.org/document/60/0,2340,en_2649_201185_35834236_1_1_1_1,00.html. The main categories included in OECD's definition of ICT (information and communications technology) goods are electronic components, computers and related equipment, audio and video equipment, and telecommunication equipment.

[17]OECD. 2005. "OECD Broadband Statistics, June 2005." October 20. Available at: http://www.oecd.org/document/16/0,2340,en_2649_201185_35526608_1_1_1_1,00.html#data2004.

[18]National Center for Education Statistics. 2006. "The Nation's Report Card: Mathematics 2005." See http://nces.ed.gov/nationsreportcard/pdf/main2005/2006453.pdf.

[19]National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Chapter 1.

[20]National Center for Education Statistics. 2004. Schools and Staffing Survey, "Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987-88 to 1999-2000 (Revised)," p. 10. See http://nces.ed.gov/pubs2002/2002603.pdf.

[21]National Center for Education Statistics. 1999. Highlights from TIMSS http://nces.ed.gov/pubs99/1999081.pdf.

[22]National Center for Education Statistics.2005. "International Outcomes of Learning in Mathematics Literacy and Problem Solving: PISA 2003 Results from the U.S. Perspective," pp. 15 and 29. See http://nces.ed.gov/pubs2005/2005003.pdf.

[23]The Business Roundtable. 2006. "Innovation and U.S. Competitiveness: Addressing the Talent Gap. Public Opinion Research." January 12. Available at: http://www.businessroundtable.org/pdf/20060112Two-pager.pdf.

[24]American Academy of Pediatrics. "Television—How it Affects Children." Available at http://www.aap.org/pubed/ZZZGF8VOQ7C.htm?&sub_cat=1. The American Academy of Pediatrics reports that "Children in the United States watch about 4 hours of TV every day"; this works out to be 1460 hours per year.

[25]National Center for Education Statistics. 2005. The Condition of Education. Table 26-2 Average Number of Instructional Hours Per Year Spent in Public School, By Age or Grade of Student and Country: 2000 and 2001. Available at http://nces.ed.gov/programs/coe/2005/section4/table.asp? tableID=284. NCES reports that in 2000 US 15-year-olds spent 990 hours in school, during the same year 4th graders spent 1040 hours.

[26]National Center for Education Statistic (2006), "Public Elementary and Secondary Students, Staff, Schools, and School Districts: School Year 2003–04". See http://nces.ed.gov/pubs2006/2006307.pdf.

[27]Analysis conducted by the Association of American Universities. 2006. National Defense Education and Innovation Initiative. Based on data in National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Appendix Table 2-33. For countries with both short and long degrees, the ratios are calculated with both short and long degrees as the numerator.

[28]National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Chapter 2, Figure 2-23.

[29]National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation.

[30]G. Gereffi and V. Wadhwa. 2005. Framing the Engineering Outsourcing Debate: Placing the United States on a Level Playing Field with China and India. http://memp.pratt.duke.edu/downloads/duke_outsourcing_2005.pdf.

[31]Ministry of Science and Technology (MOST). 2004. Chinese Statistical Yearbook 2004. People's Republic of China, Chapter 21, Table 21-11. Available at http://www.stats.gov.cn/english/statisticaldata/yearlydata/yb2004-e/indexeh.htm. The extent to which engineering degrees from China are comparable to those from the United States is uncertain.

[32]National Association of Software and Service Companies. 2005. Strategic Review 2005., India. Chapter 6. Sustaining the India Advantage. Available at http://www.nasscom.org/strategic2005.asp.

[33]National Center for Education Statistics. 2004. Digest of Education Statistics 2004. Institute of Education Sciences, Department of Education, Washington DC, Table 250. Available at http://nces.ed.gov/programs/digest/d04/tables/dt04_250.asp.

[34]Myles Boylan. 2004. Assessing Changes in Student Interest in Engineering Careers Over the Last Decade. CASEE, National Academy of Engineering. Available at http://www.nae.edu/NAE/caseecomnew.nsf/ weblinks/NFOY-6GHJ7B/$file/Engineering%20Interest%20-%20HS%20through%20College_V21.pdf; Clifford Adelman. 1998. Women and Men on the Engineering Path: A Model for Analysis of Undergraduate Careers. Washington DC: US Department of Education. http://www.nae.edu/nae/diversitycom.nsf/98b72da8aad70f1785256da20053dcaf/85256cfb00484b5c85256da000002f83/$FILE/Adelman_Women_and_Men_of_the_Engineering_Path.pdf). According to this Department of Education analysis, the majority of students who switch from engineering majors complete a major in business or other non-science and engineering fields.

[35]National Center for Education Statistics Digest of Education Statistics. The American Institute of Physics Statistical Research Center.

[36]Spencer Stuart. 2005. "2004 CEO Study: A Statistical Snapshot of Leading CEOs." Available at: http://content.spencerstuart.com/sswebsite/pdf/lib/Statistical_Snapshot_of_Leading_CEOs_relB3.pdf#search='ceo%20educational%20background'.

[37]US research and development spending in 2001 was $273.6 billion, of which industry performed $194 billion and funded about $184 billion. National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. One estimate of tort litigation costs in the United States was $205 billion in 2001. Jeremey A. Leonard. 2003. "How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness." Prepared for the Manufacturing Institute of the National Association of Manufacturers. Availbale at: http://www.nam.org/s_nam/bin.asp?CID=216&DID=227525&DOC=FILE.PDF.

[38]US Patent and Trademark Office.2006. USPTO Annual List of Top 10 Organizations Receiving Most U.S. Patents. January 10, 2006. See http://www. uspto.gov/web/offices/com/speeches/06-03.htm

[39]CERN. Internet Homepage. http://public.web.cern.ch/Public/Welcome.html.

[40]American Association for the Advancement of Science. 2004. "Trends in Federal Research by Discipline, FY 1976-2004." October. Available at: http://www.aaas.org/spp/rd/disc04tb.pdf and http://www.aaas.org/spp/rd/discip04c.pdf.

[41]Centers for Medicare and Medicaid Services. 2005. National Heath Expenditures. Available at: http://www.cms.hhs.gov/NationalHealthExpendData/downloads/tables.pdf.

[42]In: Wallace, Kathryn. 2005. "America's Brain Drain Crisis Why Our Best Scientists are Disappearing, and What's Really at Stake." Readers Digest. December.

[43]Louis V. Gerstner, Jr. Former Chairman, IBM In The Teaching Commission. 2004. Teaching at Risk: A Call to Action. New York: City University of New York. See www.theteachingcommission.org.

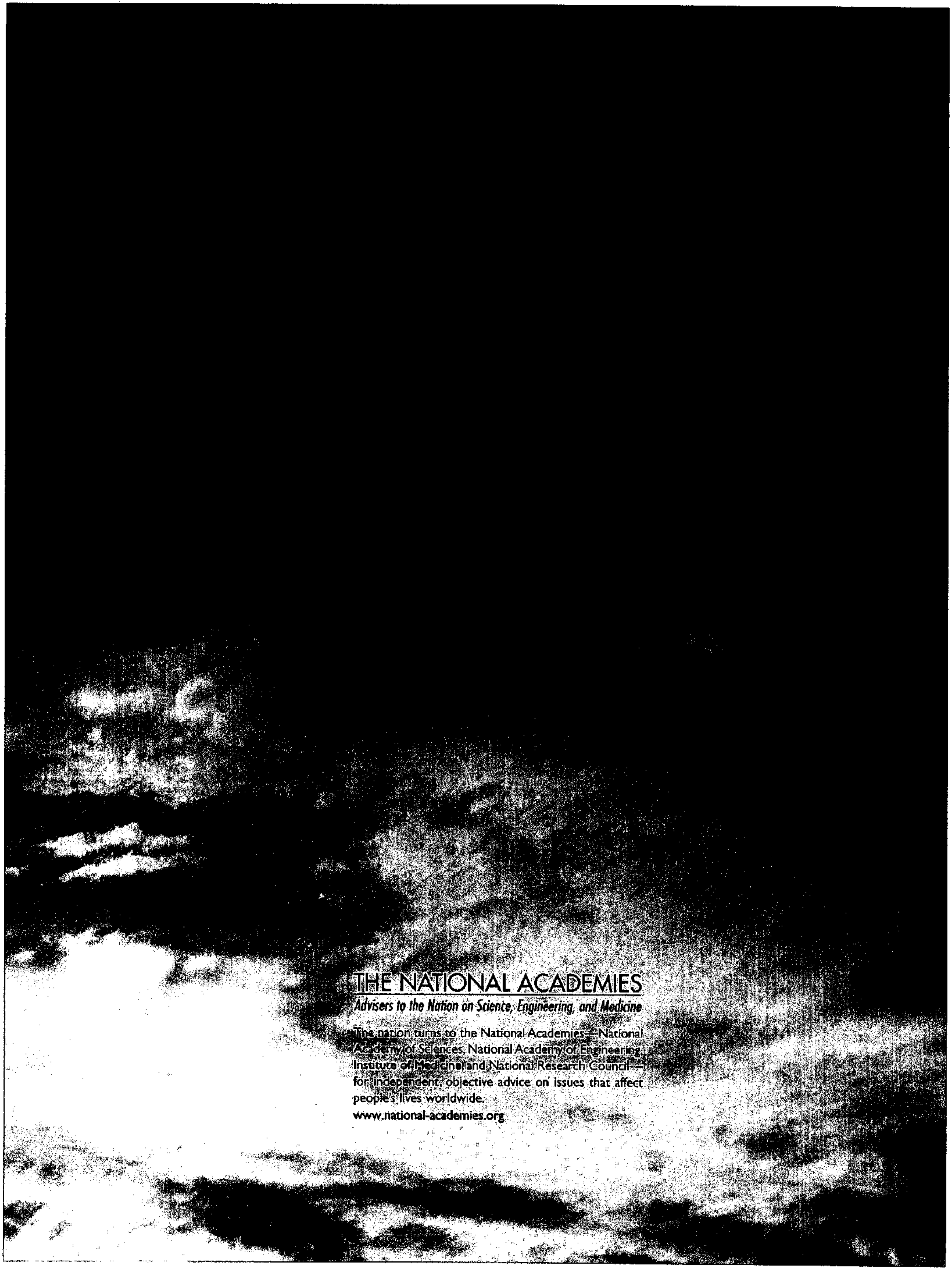
[44]Remarks by Jeffrey R. Immelt to Economic Club of Washington as reported in Neil Irwin. 2006. "US Needs More Engineers, GE Chief Says." Washington Post. January 23, 2006.

[45]Craig Barrett. 2006. Comments at public briefing on the release of The Gathering Storm report. October 12, 2005. See http://www.nationalacademies.org/morenews/20051012.html.

[46]Bill Gates. 2005. Speech to the National Education Summit on High Schools. February 26. Available at: http://www.gatesfoundation.org/MediaCenter/Speeches/BillgSpeeches/BGSpeechNGA-050226.htm.

[47]William Jefferson Clinton "Commencement Address at Morgan State University in Baltimore, Maryland." May 18, 1997 Government Printing Office. 1997 Public Papers of the Presidents of the United States, Books I and II. Available at: http://www.gpoaccess.gov/pubpapers/wjclinton.html.

[48]Remarks by President George W. Bush in meeting with High-Tech Leaders. March 28, 2001. Available at: http://www.whitehouse.gov/news/releases/2001/03/20010328-2.html.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ATTACHMENT 3

NATIONAL MATHEMATICS ADVISORY PANEL

CHAIRMAN

Larry Faulkner, president, Houston Endowment; president emeritus, University of Texas at Austin.

PANELISTS

Deborah Ball, dean of the school of education and college professor, University of Michigan.

Camilla Benbow, dean of education and human development, Vanderbilt University, Peabody College.

A. Wade Boykin, professor and director of the developmental-psychology graduate program, department of psychology, Howard University.

Francis "Skip" Fennell, professor of education, McDaniel College, Westminster, Md.; president, National Council of Teachers of Mathematics.

David Geary, curators' professor, department of psychological sciences, University of Missouri-Columbia.

Russell Gersten, executive director, Instructional Research Group; professor emeritus, college of education, University of Oregon.

Nancy Ichinaga, former principal, Bennett-Kew Elementary School, Inglewood, Calif.

Tom Loveless, director, Brown Center on Education Policy and senior fellow in governance studies, the Brookings Institution.

Liping Ma, senior scholar, Carnegie Foundation for the Advancement of Teaching.

Valerie Reyna, professor of human development and professor of psychology, Cornell University.

Wilfried Schmid, professor of mathematics, Harvard University.

Robert Siegler, Teresa Heinz professor of cognitive psychology, department of psychology, Carnegie Mellon University.

Jim Simons, president of Renaissance Technologies Corp.; former chairman of the mathematics department, State University of New York at Stony Brook.

Sandra Stotsky, independent researcher and consultant in education; former senior associate commissioner, Massachusetts Department of Education.

Vern Williams, math teacher, Longfellow Middle School, Fairfax, Va.

Hung-Hsi Wu, professor of mathematics, University of California, Berkeley.

EX-OFFICIO MEMBERS

Dan Berch, National Institute of Child Health and Human Development, National Institutes of Health.

Diane Jones, White House Office of Science and Technology Policy.

Thomas W. Luce III, assistant secretary, US Department of Education.

Kathie Olsen, deputy director, National Science Foundation.

Raymond J. Simon, deputy secretary, US Department of Education.

Grover J. "Russ" Whitehurst, director, Institute of Education Sciences, US Department of Education.

Source: US Department of Education Press Release, May 15, 2006

Protecting America's Competitive Edge Acts

Domenici-Bingaman-Alexander-Mikulski

Section-by-Section Summary of Legislative Provisions

(Updated March 14, 2006)

Protecting America's Competitive Edge through Energy (PACE-Energy)

Section 3. Mathematics, Science and Engineering Education at the Department of Energy
Amends the Department of Energy Science Education Enhancement Act to create a "Director of Mathematics, Science and Engineering Education Programs" to coordinate all Mathematics, Science, and Engineering Education Department wide. This Director reports to the Undersecretary of Science. Establishes the following programs to be administered by the Director:

> **Sec. 3171. Specialty Schools for Math and Science** – Provides for scientific and engineering staff of the National Laboratories to assist in teaching courses in statewide specialty schools in mathematics and science education, and to use National Laboratory scientific equipment in the teaching of courses.
> **Sec. 3175. Experiential-Based Learning Opportunities** – Establishes summer internships, including internships at the National Laboratories, for middle and high school students to promote experiential, hands-on learning in math and science.
> **Sec. 3181. National Laboratories Centers of Excellence in Mathematics and Science Education** – Establishes a program at each of the National Laboratories to support a Center of Excellence in Mathematics and Science at one public secondary school located in the region of the national laboratory.
> **Sec. 3185. Summer Institutes** – Establishes a program of summer institutes at each of the National Laboratories, and through grants to universities and other nonprofit entities, to strengthen the math and science teaching skills of K-12 teachers, with a particular focus on K-8 teachers.
> **Sec. 3191. Distinguished Scientists** – Establishes a program between universities and national laboratories for 100 distinguished scientists who will hold joint appointments to promote academic and scientific excellence between the two institutions.
> **Sec. 3195. Nuclear Science Education** – Establishes a competitive scholarship program for education expenses of students in nuclear science and engineering.

Section 4. Department of Energy Early Career Research Grants – Authorizes research grants for early-career scientists and engineers pursuing innovative, independent research. Eligible individuals must have completed a doctorate within the previous 10 years, and must show promise in a field of science or technology. Grants awarded under this section are for 5 years at a level of $100,000 per year during the grant period.

Section 5. Advanced Research Projects Authority – Energy – Establishes the Advanced Research Projects Authority – Energy (ARPA-E) as a new agency within the Department of Energy. The mission of ARPA-E will be to support research with the potential to overcome long-term, high-risk technological barriers in the development of applied energy technologies (including carbon neutral technologies). The Director of ARPA-E will report to the Undersecretary of Science. An external advisory board will recommend to the Director, on an annual basis, key areas of applied energy research to include in the ARPA-E research portfolio.

Section 6. Authorization of Appropriations for the Department of Energy Office of Science. – Authorizes funding for the Office of Science. The authorization follows the Energy Policy Act of 2005 through 2009 and thereafter follows the National Academy recommendation of 10 percent annual growth from the current 2006 baseline budget through 2013.

Section 7. Discovery Science and Engineering Innovation Institutes. – Establishes multi-disciplinary institutes centered at National Laboratories to apply fundamental science and engineering discoveries to technological innovations related to the missions of the Department and the global competitiveness of the United States. The Institutes are required to support scientific and engineering research and education activities on critical emerging technologies determined by the Secretary to be essential to global competitiveness.

Section 8. PACE Graduate Fellowship Program. – Establishes an elite graduate fellowship program for students pursuing doctoral degrees in mission areas of the Department. The section requires that students be selected for the fellowship program through a competitive merit review process (involving written and oral interviews) that will result in a wide distribution of awards throughout the United States.

Protecting America's Competitive Edge through Education and Research (PACE-Education)

Sec. 121. Baccalaureate Degrees in Mathematics and Science with Teacher Certification – The Secretary of Education shall award grants to departments of mathematics, science, or engineering at institutions of higher education that partner with teacher preparation programs to provide integrated courses of study that lead to a baccalaureate degree in math, science, or engineering with concurrent teacher certification.

Sec. 122. Master's Degree in Mathematics and Science Education for Teachers – The Secretary shall award grants to departments of mathematics, science, or engineering at institutions of higher education that partner with teacher preparation programs to develop and provide part-time, 3-year master's degree programs in math and science education for current teachers.

Sec. 132. National Science Foundation (NSF) Scholarships for Mathematics and Science Teachers – The Director of the NSF shall award merit-based scholarships up to $20,000 per year for up to four years to students majoring in mathematics, science, or engineering who pursue concurrent teacher certification to assist the students in paying their college education expenses. Such expenses shall include tuition, fees, books, supplies, and equipment required for courses of instruction.

Sec. 141. NSF Fellowships for Mathematics and Science Teachers – The Director of the NSF shall award 2 types of fellowships to math and science teachers: 1) The Director shall award

$10,000 annually for four years to individuals who complete a baccalaureate degree in science, engineering, or mathematics, with concurrent teacher certification, and teach as a full-time mathematics, science or elementary school teacher in a high-need public elementary or secondary school; 2) The Director shall award $10,000 annually for five years to teachers who have successfully completed a master's degree in science or mathematics education and who undertake increased responsibilities, such as teacher mentoring and other leadership activities.

Sec. 151. Advanced Placement and International Baccalaureate Programs – The Secretary of Education shall award grants to nonprofit entities to work with local school districts to:

1. provide training to teachers to teach Advanced Placement or International Baccalaureate (AP-IB) programs in mathematics and science, or pre-AP-IB programs in mathematics and science, and
2. increase the number of students who take pre-AP-IB and AP-IB courses in mathematics and science, and take and pass the AP-IB exams in mathematics and science.

Sec. 161. National Clearinghouse on Mathematics and Science Teaching Materials – The Secretary of Education shall convene a national panel to collect proven effective K-12 mathematics and science teaching materials, and create a clearinghouse of such materials for dissemination to states and school districts.

Section 171. NSF Early Career Research Grants – Authorizes through fiscal year 2011 an independent research program for scientists and engineers who have completed their professional degrees within 10 years of the date of enactment of the Act

Section 211. Coordination of Science, Mathematics and Engineering Education Programs. – Creates a standing subcommittee in the President's Committee of Advisors on Science and Technology to develop national goals for education in mathematics, science, and engineering across the various federal agencies that conduct such programs. Creates a Deputy Assistant Director for Science, Mathematics and Engineering in the Office of Science and Technology Policy to coordinate the federal budgets for education programs in science, mathematics and engineering as part of the annual budget submission of the President to Congress.

Section 212, National Coordination Office for Advanced Research Instrumentation and Facilities. –Directs the Office of Science and Technology Policy to coordinate the federal budget for research instrumentation at the Departments of Defense, Energy, NASA and the National Science Foundation with a supplemental authorization of appropriations for the named agencies for additional equipment grants.

Section 213. High-Risk, High-Payoff Research. – Directs the Office of Science and Technology Policy in consultation with the Office of Management and Budget to develop guidelines for federal research agencies to allow eight percent of R&D budgets to be devoted to high-risk, high payoff research which falls outside the peer review and budget allocation processes.

Section 214. President's Innovation Award. –Authorizes an Innovation Award to be delivered by the President for innovation amongst the interagency R&D priorities determined each year by the Directors of the Office of Science and Technology Policy and Office of Management and Budget. The award consists of a significant cash prize, a medal and a certificate.

Section 221. National Aeronautics and Space Administration Early Career Research Grants - Authorizes through fiscal year 2011 an independent research program for scientists and engineers who have completed their professional degrees within 10 years of the date of enactment of the Act.

Section 222. Authorization of Appropriations of the National Astronautics and Aerospace Administration. –Increases the NASA basic research budget 10 percent annually through 2013.

Section 231. Sense of the Senate on Policies to Accelerate Deployment of Access to Broadband Internet. Provides that it is the Sense of the Senate that Congress and the FCC should work together to ensure the implementation of regulatory polices that facilitate and accelerate access to broadband internet.

Section 241. Development of Science Parks. – Supports the development of science parks through infrastructure planning grants and loan guarantees so that U.S. science parks are competitive with those throughout Asia.

Section 251. Authorization of Appropriations for the National Science Foundation. – Increases the NSF Research and Related Activities budget 10 percent annually through 2013.

Section 312. Sense of the Senate on Improving Visa Processing for Students and Researchers. Provides that it is the Sense of the Senate that the Department of State and the Department of Homeland Security review of the application of the Technology Alert List and work to better facilitate travel related to scientific conferences. The bill also recognizes recent improvements that have been made with respect to the Visas Mantis clearance process.

Section 313. Visas for Doctorate Students in Mathematics, Engineering, Technology, or the Physical Sciences. Creates a new "F-4" student visa for doctoral candidates studying in the fields of math, engineering, technology, or the physical sciences. After completing their doctoral program, eligible students could either return to their country of origin or remain within the United States for up to 1 year to seek employment in their relevant flied of study. Upon gaining employment, the individual would also be permitted to adjust his or her status to that of a legal permanent resident after paying a $1,000 fee and passing relevant security checks. Of the required fee, 80 percent would be deposited in a fund designated for job training and scholarships for American workers and 20 percent in a fraud prevention account.

Section 314. Aliens Not Subject to Numerical Limitations on Employment-Based Immigrants. Exempts the following categories of people from the numerical limitations on employment-based immigrants:

(1) aliens who have earned an advanced degree in science, technology, engineering, or math and have been working in a related field in the United States under a temporary visa during the 3-year period preceding their application for an immigrant visa;
(2) certain aliens who have shown "extraordinary" abilities in their line of work or who have received a "national interest waiver"; and
(3) the immediate relatives of aliens who are admitted as employment-based immigrants.

Section 321 – Sense of the Senate on Patent Reform. – Provides that it is the Sense of the Senate that funding for the US Patent and Trademark Office should receive a 20% increase in funding and that Congress should implement comprehensive patent reform per recommendations from the National Academies.

Section 401. Sense of the Senate on Deemed Export Controls. – Support the National Academy recommendation to reform proposals to the deemed export controls at universities by ensuring basic R&D is exempt.

Section 501. Department of Defense Early Career Research Grants - authorizes through fiscal year 2011 an independent research program for scientists and engineers who have completed their professional degrees within 10 years of the date of enactment of the Act.

Section 502. Authorization of Appropriations for Basic Research at the Department of Defense. - Supports the National Academy recommendation by increasing the DOD 6.1 basic research budget 10 percent annually through 2013.

<u>Protecting America's Competitive Edge through Tax Incentives (PACE-Tax)</u>

Section 1. Expansion of Credit for Research and Development – Doubles the current R&D tax credit (20% to 40%) and expands the credit to allow 100% of the cost of all research conducted by consortium, small businesses, federal laboratories and universities (current law limits the 100% cost inclusion to energy research). The entire R&D tax credit would also be made permanent. Finally, the provision requires the Treasury Department to report back to the President and Congress on moving the incremental approach to determining the credit for companies with significant and consistent research and development expenses. The Treasury will also include an analysis of expanding the credit to include employee benefit costs, 100% of contract costs, Section 174 expenses and any other costs determined appropriate by the Treasury. Finally, the Treasury will report back on the reduction or elimination of the limitation of the credit under Section 280C(c).

Section 2. United States-Based Innovation Incentives Study – Requires the Treasury Department, in consultation with OMB, to analyze of the U.S. tax system and its effect on the U.S. being the site selected by private entities for innovation investment and related activities. This analysis will include looking at the treatment of capital gains, corporate rates and incentives for high-tech manufacturing and research equipment. Treasury must complete this analysis and report to the President and Congress within 180 days of enactment.

Section 3. Employee Continuing Education Credit – Provides for a tax credit of up to $500,000 annually to employers who provide qualified education to maintain or improve employees' knowledge in science or engineering.